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EFFECTS OF CHEMICAL WEAPONS ON HUMAN HEALTH AND THE ENVIRONMENT

Report of the Executive Director

Summary

The present report, which is being submitted to the Council in accordance with paragraph 3 of Council decision 15/9 of 25 May 1989, consists of three parts: part I (paras. 3-22) describes the various types of chemical weapons and how they might be used in war; part II deals with the behaviour of chemical warfare agents in the environment (paras. 23-35) and the threat such agents pose to civilians (paras. 36-41), crops and livestock (paras. 42-45) and the natural environment (paras. 46-54); and part III (paras. 55-71) is devoted to the legal, diplomatic and cultural constraints on the use of chemical weapons.

The main conclusions of the report as regards the effects of chemical weapons on human health and the environment in the event of chemical warfare are as follows:

(a) Chemical weapons could pose a severe threat to the embroiled civilian population inadvertent exposure could become an especially serious problem in military theatres with a high population density or in which refugees are on the move. Intentional exposure might even involve the inhabitants of entire cities;

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* UNEP/GC.16/1.

(b) Human exposure to chemical weapons could lead to acute suffering, often with rapid death as the outcome. Medical intervention might be largely ineffectual. In any event, the numbers of victims could well overburden available medical personnel and facilities. Survivors might experience a range of debilitating long-term effects;

(c) The environment, including both fauna and flora, could be damaged either inadvertently or by intent. Overall ecosystem disruption could have catastrophic consequences, with ecological recovery taking years, decades or even centuries.

Suggested action by the Governing Council

The Governing Council may wish to:

1. Consider that chemical warfare has both an anti-environmental dimension, which might attain the level of mass destruction or even ecocide, and an anti-social dimension, which might attain the level of mass annihilation or even genocide;

2. Condemn unequivocably chemical warfare and call upon other United Nations bodies to do likewise;

3. Urge the United Nations Conference on Disarmament to note the present report and to take it into consideration in pursuing negotiations on effective measures to proscribe the development, production, stockpiling and use of chemical weapons;

4. Request the Executive Director in consultation with the Director-General of the World Health Organization, to make appropriate arrangements so that expert advice on the environmentally sound disposal of existing chemical weapons may be provided by the two organizations.

INTRODUCTION

1. The present report is being submitted to the Governing Council in response to paragraph 3 of its decision 15/9 of 25 May 1989, by which the Council requested the Executive Director "to prepare a comprehensive report on the devastating effects of chemical weapons on human health and the environment, as well as ways and means of strengthening international co-operation in this regard, for submission to the Governing Council at its sixteenth regular session".

2. The report has been prepared on the basis of a consultant's report, itself the product of extensive collaboration with a number of high-level expert scientific consultants and advisers, which included a symposium hosted by the United Nations Institute for Disarmament Research (UNIDIR) and held from 14 to 16 May 1990. The full text of the consultant's report, as submitted to the UNEP secretariat, is available upon request.

I. CHEMICAL WEAPONS

A. General categories of chemical weapons

3. The term "chemical weapon" is employed in the present report in accordance with the most recent tentative definition of the United Nations Conference on Disarmament, which considers chemical weapons to be toxic chemicals, including super-toxic lethal chemicals, other lethal chemicals, other harmful chemicals, and their precursors, either separately or together with their associated munitions and equipment for use. Although a chemical weapon is used for hostile purposes on the basis of its toxic properties, its psychological impact in causing terror or panic is also of importance. Chemical weapons could be directed against enemy military personnel, against enemy civilian population (whether urban or rural), against enemy livestock or enemy crops, or against enemy natural ecosystems; or else they could impinge upon one or more of these targets collaterally.

4. Chemical weapons can be categorized according to their intended target as being:

(a) Anti-personnel;

(b) Anti-animal (or anti-livestock);

(c) Anti-plant (or anti-crop).

5. Chemical weapons are sometimes categorized, with greater or lesser precision, according to their duration of potency in the field as being:

(a) Non-persistent (generally effective for minutes);

(b) Semi-persistent (generally effective for hours);

(c) Persistent (generally effective for days or weeks).

6. Chemical warfare agents are usually synthetic compounds. They may, however, be of natural (biotic) origin, having been produced by a living organism (e.g., by a bacterium, a fungus, or a snake), in which case they are referred to as toxin agents. Despite its chemical nature, a toxin agent is usually considered by diplomats together with biological warfare agents (i.e., together with living pathogenic organisms that could be employed for hostile purposes).

7. A chemical weapon is usually a single active chemical compound (a unitary agent). Some, however, can be formulated so that two chemical compounds substantially less dangerous (or, perhaps, substantially more stable) than the end product are caused to mix and react en route to the target, thereby creating the agent of desired effectiveness at the time of impact. Such a chemical weapon is referred to as a binary munition. Comparable multi-component munitions are presumably also feasible.

8. Chemical warfare agents can be gaseous, liquid, or solid under ambient conditions of temperature and pressure. However, all or most of them can be formulated for delivery to the target as a gas or else as an aerosol - hence the continued general use of the term "poison gas".

B. Anti-personnel weapons

9. Anti-personnel chemical weapons can be divided, with greater or lesser precision, according to their general level of toxicity as being:

(a) Harassing or irritant;

(b) Incapacitating;

(c) Lethal.

10. The most poisonous of the lethal agents have been referred to as "super-toxic" and the less than lethal agents have been referred to as "harmful". It is important to point out here that the actual level of danger of any particular chemical weapon would depend upon its formulation, manner of application, the concentration employed, the nature or condition of the recipient, and the route by which it is taken up.

11. Anti-personnel chemical weapons can for convenience also be divided on the basis of their apparent initial primary physiological action or target organ, for example:

(a) Nerve agents, which initially primarily attack the nervous system;

(b) Blood (or, better, systemic) agents, which initially seem to primarily poison the blood;

(c) Lung (or respiratory or choking or suffocating) agents, which initially primarily asphyxiate;

(d) Dermal (or cutaneous or vesicant) agents, which initially primarily blister or otherwise damage the skin;

(e) Psychotropic agents, which initially primarily cause behavioural disorientation or other mental problems;

(f) Vomiting (or emetic) agent, which initially primarily produce nausea;

(g) Lacrimatory (or tearing) agents, which initially primarily irritate the eyes and mucous membranes.

12. Harassing anti-personnel chemical weapons of various sorts are, or could be, available to armed forces. CS, a white, odourless, oil-soluble, pulverized solid, provides a useful example. CS can be classed as a semi-persistent (CS1) to persistent (CS2) agent inasmuch as it can be formulated so as to be more or less rapidly degradable under field conditions. Its debilitating effects (irritation of the eyes, respiratory passages, etc.) occur within a few seconds; they are generally transient, especially when administered in the open, requiring no medical attention (although certain vulnerable groups could be at risk, e.g., infants, the elderly, the sick).

13. Lethal anti-personnel chemical weapons of various sorts are, or could be, available to armed forces. Two examples are mustard gas, an initially primarily dermal agent, and VX, a nerve agent, both of which can be classed as persistent since they remain potent under field conditions for up to several weeks.

14. Mustard gas is an almost colourless (unless impure) oil-soluble liquid having somewhat of a mustard-like odour. Its early debilitating effects (primarily skin lesions, itching, and eye damage, i.e., chemical conjunctivitis) occur within a few hours; internal trauma, including severe depression of the immune system, occurs within several days. Mustard gas acts by disrupting cellular functioning in animals, both vertebrates and invertebrates (and, to some extent, also in plants) owing to its ability to introduce the ethyl or similar hydrocarbon radical into various compounds of physiological importance (i.e., to alkylate them), thereby preventing them from serving their purpose. Exposed individuals require immediate decontamination of the skin and rapid medical attention.

15. VX is a thick, oil-soluble, essentially colourless, and apparently odourless liquid. It is non-volatile and lends itself to aerosol dispersion and also to dispersion via larger droplets. Moreover, it can be formulated as a binary munition. The debilitating effects of VX (a host of adverse symptoms) occur within a few minutes. VX, which is in the same family of chemicals as the organophosphorous insecticides, acts by interfering with the transmission of information at synapses in the nervous system and at the junctions between nerves and the organs they service, such as glands or muscles. Exposed individuals require immediate medical attention, which suggests the need for immediate self-administered treatment.

C. Anti-animal and anti-plant weapons

16. Anti-animal chemical weapons do not differ from anti-personnel chemical weapons, except in so far as they are intended for use against enemy livestock, whether mammalian or avian.

17. Anti-plant chemical weapons are identical or similar to herbicides routinely used in forestry, range management, agriculture, and other activities. One example is 2,4,5-T, a thick, non-volatile, oil-soluble liquid, usually employed either in an oil-soluble ester formulation or in a water-soluble salt formulation. Like mustard gas and VX, 2,4,5-T can be classed as a persistent agent since it remains potent under field conditions for up to several weeks. 2,4,5-T acts on plants by performing the function of a growth hormone at an excessive level, thereby disrupting their normal metabolism. It generally exerts only a minor effect on humans or other animals, including transient eye irritation and perhaps mild gastrointestinal disturbance, requiring no medical attention (although certain impurities have the potential for causing more serious medical problems).

D. Possible use of chemical weapons

18. Chemical warfare agents could be delivered to their target overtly by projectiles (grenade, shell, bomb, rocket, missile, etc.) or, for some such agents, by spray equipment (mounted on vehicles, boats, or aircraft). They could be incorporated into land mines. They could, of course, be employed singly, in various combinations, or in conjunction with other types of weapons. Additionally, chemical weapons could be delivered to their target covertly by saboteurs, such delivery being able to take a variety of forms. It is well within present military capabilities to mount an attack with chemical weapons over an area of tens, if not hundreds, of hectares.

19. Harassing anti-personnel chemical weapons such as CS could be used for the purpose of achieving one or more of the following direct goals:

(a) To harass enemy military personnel;

(b) To induce concealed enemy military personnel to give up their cover;

(c) In a slowly degradable formulation, to render an area more or less inhospitable for a period of up to several weeks.

20. It might be added that harassing agents are often available for use by police forces and prison guards for purposes of riot control.

21. Lethal anti-personnel chemical weapons such as mustard gas or VX could be used for the purpose of achieving one or more of the following direct goals:

(a) To produce human casualties, either among enemy military personnel or among the enemy civilian population;

(b) To deny the use of an area (i.e., to make it untenable or inhospitable) for a certain period of time - possible areas including, by way of example, defensive perimeters, airfields, port facilities, supply depots, industrial sites, reservoirs, and urban areas;

(c) To reduce their operational capability of enemy military personnel by forcing them to resort to protective masks (respirators) and clothing, or to confine them to shelters;

(d) To instil terror in enemy military personnel or civilian population.

22. Anti-animal chemical weapons such as VX could be used to destroy enemy cattle or other livestock, while anti-plant weapons such as 2,4,5-T could be used to deny to enemy military personnel the concealment afforded by trees or other plants or to destroy enemy food or industrial crops.

II. IMPACT OF CHEMICAL WEAPONS ON THE ENVIRONMENT

A. Behaviour of chemical weapons in the environment

23. The initial release of a chemical warfare agent could give rise to a ground-hugging gaseous or aerosol cloud of potent concentration and considerable extent. As indicated earlier, the attacked area could cover several tens or even several hundreds of hectares. Moreover, the attack could be repeated in the same or adjacent areas.

24. The initial cloud would increase in size and thus decrease in concentration, primarily because of wind and general atmospheric turbulence. Agent concentration would decrease further as a result of deposition, through the action of gravity, rainfall or interception (by topographical features, trees, buildings or other obstructions.

25. The agent may be deposited on land, bodies of water, or artificial structures. Once on the ground, a modest amount of the agent might return to the atmosphere via evaporation or sublimation, depending largely upon the volatility of the agent and existing temperature, wind, and perhaps moisture conditions. Some of the deposited agent could be washed away on or near the ground surface or else could percolate downward. This latter phenomenon would, however, depend to a considerable extent upon the water solubility of the agent, although water-insoluble particles would also be subject to such dispersion to some extent, being carried along by running water, either independently or after becoming attached to soil particles, which is often the case.

26. The actual dispersion of a chemical warfare agent would therefore depend upon a variety of factors, important among them:

(a) The physical and chemical natures of the agent itself;

(b) The means of application;

(c) The meteorological conditions at the time of attack;

(d) The nature of the terrain being attacked.

27. Once a chemical warfare agent has been deposited, the affected area would remain contaminated with the chemical agent for varying lengths of time. Various natural mechanisms would be involved in the area again becoming harmless, as the contaminant either disappears or becomes sequestered. The rate of detoxification by natural and/or human processes would depend upon a host of factors.

28. A chemical warfare agent would disappear naturally from an area in some combination of the following two ways:

(a) Dispersal in the ways mentioned in paragraph 25 above;

(b) Decomposition by chemical or biological means.

29. Chemical decomposition of chemical warfare agents occurs most readily under moist conditions, that is, when the chemical agent has the opportunity to react with water (such decomposition being referred to as hydrolysis). Chemical decomposition almost always occurs more rapidly as the ambient temperature increases. Moreover, various chemical warfare agents can be formulated so as to make them more or less readily degradable.

30. The early products of the chemical decomposition of chemical warfare agents are less toxic than the original agent, and the ultimate products benign. For example, the most toxic initial product of VX hydrolysis is an order of magnitude less toxic than the original agent, but, on the other hand, is more stable.

31. Biological decomposition of chemical warfare agents is brought about by micro-organisms (usually soil bacteria or fungi) that, on the one hand, are not poisoned by the agent and, on the other, are able to metabolize the agent. In fact, soil micro-organisms seem to be relatively immune to the various chemical warfare agents that might be employed, including the anti-plant agents. It therefore might be tentatively suggested that biological decomposition would often play a more important role in environmental detoxification than would chemical decomposition.

32. A contaminated area would become naturally harmless again not only as a result of the disappearance mechanisms just outlined but also, to a lesser but varying extent, through sequestering. For example, a chemical warfare agent can become absorbed to the clay particles and, even more so, to the humic substances in the soil, thereby precluding its uptake or absorption by plants or animals. Thus, a high organic-matter content in the soil would favour such sequestering.

33. Human intervention of various sorts could speed up the natural detoxification of an area that had been attacked by chemical weapons, such intervention, of course, generally only being feasible for quite small areas. Clean-up activities, such as rinsing or washing, volatilizing with steam, or the application of neutralizing chemicals, might be especially called for in an urban environment. Moreover, it might be possible to develop micro-organisms for field application that would break down certain chemical warfare agents. On the other hand, some decontaminating agents might be environmentally harmful in their own right: for example, chlorinated lime ('bleaching powder') could be used in the field as a decontaminating agent for mustard gas (and, with lesser efficacy, for VX), but is highly toxic to most forms of life during the time before it decomposes.

34. Unexploded chemical munitions could also be present in the environment. In an attack, a fraction of such munitions sufficient to cause a serious problem would be likely to fail to detonate at the time of initial employment. It might well be desirable to have trained personnel to locate and dispose of these dangerous remnants of battle so as to avoid subsequent accidental detonation or, in time, the dispersal of any still active chemical warfare agent once the casings deteriorate.

35. Chemical munitions could also be present in the environment as a result of having been discarded once they are no longer needed, for example, by burial or ocean dumping. Again, the agents could pose a danger following the corrosion or accidental rupturing of their casings. It would be desirable to identify such disposal sites so as to permit monitoring for public health and environmental safety, and perhaps isolation or decontamination.

B. Threat of chemical weapons to civilians

36. Civilians could be subject to either inadvertent exposure to or intentional attack by chemical weapons. Inadvertent exposure could come about if the people in question were too close to the battle zone, especially in large-scale chemical attacks within heavily populated military theatres. Refugees fleeing the area of battle would be especially vulnerable to exposure, particularly since dangerous amounts of chemical warfare agents could readily be transported several to tens of kilometres under windy conditions. Intentional exposure could come about if civilian targets were attacked.

37. Possibilities for civilian exposure beyond direct attack exist, of course, and include:

(a) Exposure during rescue operations, decontamination, or medical treatment;

(b) Exposure during research and development;

(c) Occupational exposure by workers in chemical-weapon factories;

(d) Exposure owing to inadvertent release of chemical warfare agents in storage or in transit;

(e) Exposure during disposal operations.

38. If an unprepared city were to be attacked with VX, it is likely that a substantial fraction of its population would be killed and another substantial fraction rendered seriously ill and thus requiring heroic supportive care. Hospital facilities in the region might well become seriously overtaxed, certainly so in many parts of the world. Burial of the dead might also present a major problem. Moreover, the possibility exists that a number of the exposed survivors would suffer from some persistent paralysis.

39. The level of injurious action on humans (unprotected by effective masks, suits or shelters) would depend on numerous factors, the most important of which include:

(a) The type of agent;

(b) The route or routes of entry (inhalation, skin or mucous-membrane absorption, ingestion);

(c) The dose absorbed (this being a factor of ambient concentration plus duration of exposure);

(d) The physical condition or individual susceptibility of the victim;

(e) Prior or subsequent medical actions taken, to the extent that these are efficacious.

40. If non-lethal, the level of injury could range from mild and transient to severe and long-term or permanent. Different chemical warfare agents might cause one or more type of long-term or delayed injury, including somatic (including carcinogenic, impaired immune functioning, premature aging), mutagenic (genetic), teratogenic (i.e., causing birth defects), and psychological or psychiatric.

41. The primary mode of action and acute symptoms of CS, mustard gas, VX and 2,4,5-T were described in paragraphs 12-15 above. Observations as well as indirect laboratory tests have also suggested a number of delayed or long-term effects of exposure to some of these chemical warfare agents. Thus, mustard gas might cause permanent eye damage, respiratory impairment, and increased susceptibility to bacterial infections via damage to the immune system. It might also lead to carcinogenic effects (e.g., lung cancer - as has been demonstrated by industrial exposures) and mutagenic effects, and the possibility of psychological or psychiatric effects has also been suggested.

C. Threat of chemical weapons to crops and livestock

42. Crops and livestock, like the civilian population, could be subject to the action of chemical weapons as a result of either inadvertent exposure or intentional attack.

43. Regarding the inadvertent exposure of crops and livestock to chemical warfare agents, the Council is referred to the section below on the threats to fauna and flora (paras. 47-54).

44. Regarding an intentional attack against crops, anti-plant chemical weapons such as 2,4,5-T, if applied at militarily significant levels, could destroy any food or industrial crop, whether herbaceous or woody. In the case of 2,4,5-T, attacked agricultural fields could be successfully replanted within several months, which in most instances would mean during the subsequent growing season. Thus, the renewed harvesting of any particular crop that had been destroyed would have to await the months or years it takes for that plant to attain a harvestable condition.

45. In the case of an intentional attack against livestock, anti-animal chemical weapons such as VX, if applied at militarily significant levels, could destroy exposed domestic animals, whether mammalian or avian. In the case of VX, attacked livestock areas could in general be safely re-used for livestock within several weeks.

D. Threat of chemical weapons to natural habitats

46. The botanical and zoological - and therefore ecological - consequences of chemical warfare could run the gamut from inconsequential to disastrous, depending, of course, primarily on the chemical warfare agent employed and, to a lesser extent, on the nature of the target area and on the time of year. The effects of the application at militarily significant levels of the four chemical warfare agents described earlier - VX, mustard gas, CS, and 2,4,5-T, - are dealt with below by way of example, first in terms of flora and then in terms of fauna.

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1. Flora

47. VX would probably have no discernible effect on the vegetation within the target area. Mustard gas would cause only a modest and CS only a very low level of injury.

48. The anti-plant chemical weapon 2,4,5-T, however, could severely injure, and often kill, most of the terrestrial (and some of the aquatic) vegetation with which it came in contact within the target area. Beyond the direct target area, lower levels of exposure from atmospheric drift would kill only the more sensitive species (in this instance, many of the herbaceous flowering plants). The level of 2,4,5-T within the target area would decrease to insignificance over a period of between several weeks and several months. Any vegetation that escaped severe injury or death in the first attack (or any subsequent re-growth of vegetation) could be more or less readily destroyed by a second attack.

49. The loss of vegetation in an area - especially in hilly terrain and in a rainy region - could lead to severe site degradation through the loss in the runoff of dissolved nutrients ("nutrient dumping") and of mineral particles (accelerated soil erosion). In more arid areas there would be an acceleration of wind erosion. In coastal areas the loss of stabilizing vegetation could lead to a retreat of the shoreline. Both nutrient dumping and accelerated erosion would continue until an adequate plant cover became re-established, in many instances during the subsequent growing season (barring a follow-up attack).

50. The replacement vegetation in a denuded area might well represent a retrogression in the successional stage of the plant community, as compared with the pre-existing plant community (and thus also a retrogression of the animal community, and even of the soil system). Thus, an attainment of the ante-bellum status might take years (for a grassland community), decades (for a forest community), or even centuries (for a tundra community).

2. Fauna

51. VX would be lethal to all of the non-human vertebrates present within the target area. It would additionally kill many of the invertebrates, particularly various arthropods (insects, etc.). Exposed vegetation, although itself apparently unaffected, would absorb the VX and then for a few weeks be a secondary source of contamination for the herbivores that feed upon it. Similarly, contaminated insects could for a brief time provide a source of secondary contamination for insect-eating birds and other insectivores. The level of VX within the target area would decrease to insignificance over a period of several weeks. Thus, although, the VX would not itself become a long-term addition to the environment, it could nevertheless result in an immediate zoological - and hence ecological - catastrophe within the immediate target area and somewhat beyond.

52. Mustard gas would kill or injure much of the exposed animal life within the target area, both vertebrate and invertebrate. The level of mustard gas within the target area would decrease to insignificance over a period of between several days and several weeks.

53. CS would be harassing and toxic to the warm-blooded vertebrates within the target area at roughly the same (or perhaps somewhat lower) levels than it would be to humans. For example, in laboratory trials, rats, mice and pigeons have been found to be slightly more tolerant of CS exposure than humans; and guinea-pigs and rabbits slightly less so. In field trials, horses and chickens have been found to be more tolerant of CS than humans. The level of CS within the target area would decrease to insignificance over a period of several days (in the CS1 formulation) to several weeks (in the CS2 formulation).

54. 2,4,5-T would cause little direct injury to the animal life within the target area. On the other hand, many herbivores (a category that includes most animal life) would find it difficult to find sufficient food to sustain themselves adequately during the several months or more than it would take to re-establish a plant cover of some sort. Some animals would suffer from the temporary loss of cover normally afforded them by the vegetation. Moreover, the post-attack replacement vegetation could be quite different from the pre-attack vegetation and would thus not provide an appropriate habitat for many of the forms of lower and higher animal life previously resident in the target area.

III. CONSTRAINTS ON THE USE OF CHEMICAL WEAPONS

A. Legal constraints

1. Existing legal constraints

55. Existing legal constraints on chemical warfare fall into two major categories:

(a) Non-specific constraints, which may be based either on the means or on the effects of warfare;

(b) Specific constraints, which may be based either on the use or on the possession of chemical weapons.

56. The fundamental non-specific means-based constraint on chemical warfare derives from the principle that the right of belligerents to adopt means of injuring the enemy is not unlimited. That principle is set out in article 22 of the regulations concerning the laws and customs of war on land annexed to the Hague Convention IV of 1907. 1/ Similarly, the 1977 Protocol Additional to the Geneva Conventions of 12 August 1949, and Relating to the Protection of Victims of International Armed Conflicts 2/ states, in its article 35, paragraph 1, that in any armed conflict, the right of the parties to the conflict to choose methods or means of warfare is not unlimited. To date, some 69 per cent of all States, including all of the five permanent members of the United Nations Security Council, are formally committed to this legal norm. Other non-specific means-based constraints on chemical warfare derive from more general treaty-based restrictions on military activities within certain domains - for example, Antarctica and outer space.

1/ J.B. Scott, ed., The Hague Conventions and Declarations of 1899 and 1907 (3rd ed.) (New York, Oxford University Press, 1918), p. 100.

2/ United Nations, Treaty Series, vol.1125, No. 17512.

57. A major non-specific effect-based constraint on chemical warfare is the principle laid down in article 35, paragraph 3, of the above-mentioned Protocol Additional to the Geneva Conventions of 1949 that it is prohibited to employ methods or means of warfare which are intended, or may be expected to cause widespread, long-term and severe damage to the natural environment. To date, about 54 per cent of all States, including two of the five permanent members of the United Nations Security Council, are formally committed to this norm. This principle is complemented by a somewhat similar, no less stringent, constraint set down in article I, paragraph 1, of the 1977 Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques, 3/ by which the parties undertake not to engage in military or any other hostile use of environmental modification techniques 4/ having widespread, long-lasting or severe effects as the means of destruction, damage or injury to any other state party. As of mid-1990, 53 States, including three permanent members of the Security Council, were parties to that Convention.

58. Another non-specific effect-based constraint on chemical warfare derives from more general treaty-based restrictions on the infliction of so-called unnecessary or inhumane suffering.

59. The most important specific use-based constraint on chemical warfare is the all-encompassing prohibition against the use in war of asphyxiating, poisonous or other gases and of all analogous liquids, materials or devices, laid down in the Geneva Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or Other Gases, and of Bacteriological Methods of Warfare, of 17 June 1925. 5/ To date, about 70 per cent of all States, including all permanent members of the Security Council, are parties to this Protocol, leading some authorities to suggest that the legal proscription has come to extend to all States as a rule of customary law. It should, however, be noted that less than two thirds of the States party to the Protocol, and none of the five permanent members of the United Nations Security Council, have not reserved the option to retaliate in kind. There are also earlier prohibitions on the employment of chemical weapons, including the Hague Declaration of 29 July 1899 concerning asphyxiating gases, 6/ by which the parties agreed to abstain from the use of projectiles the sole object of which is the diffusion of asphyxiating or deleterious gases, and article 23 of the regulations annexed to the Hague Convention IV of 1907, which prohibits the employment of poison or poisoned weapons.

3/ General Assembly resolution 31/72, annex.

4/ Article II of the Convention defines "environmental modification techniques" as "any technique for changing - through the deliberate manipulation of natural processes - the dynamics, composition or structure of the earth, including its biota, lithosphere, hydrosphere and atmosphere, or of outer space".

5/ League of Nations, Treat Series, Vol. XCIV (1929), No. 2138.

6/ Scott, op. cit., p. 225.

60. The only specific possession-based constraint in chemical warfare is the unambiguous prohibition against the development, production, stockpiling or other acquisition or attention of toxin weapons, contained in article I of the 1972 Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and On Their Destruction. 7/ In addition, by article IX of the Convention, the parties affirm the recognized objective of effective prohibition of chemical weapons and undertake to continue negotiations on effective measures for the prohibition of their development, production and stockpiling. To date, about 65 per cent of all states, including all five permanent members of the United Nations Security Council, are parties to the Convention.

2. Proposed legal constraints

61. There appears to be no urgent need to propose additions to the corpus of non-specific legal constraints on chemical warfare, either as regards the mean of warfare or as regards its effects

62. A number of reservations notwithstanding, the existing specific legal constraints in chemical warfare are in principle all-encompassing. There is now even a procedure for the investigation of alleged violations of the 1925 Geneva Protocol or other relevant rules of customary international law, which has been developed under the auspices of the General Assembly. 8/ The existing formal constraints on the possession of chemical weapons as yet only apply to toxin weapons and are therefore inadequate. An all-encompassing prohibition on chemical weapons would be most valuable. In fact, as mentioned in paragraph 60 above, the majority of States are firmly committed to achieving such a prohibition. Negotiations to this end have been the progress of the past two decades, primarily within the framework of the United Nations Conference on Disarmament. Besides the 40 States members of the Conference, 36 non-members are participating in the negotiations. Progress in the elaboration of the text of the draft convention continues. The so-called "rolling text" - a continuously updated and expanded draft convention - now amounts to some 50 pages. 9/ The technical issues involved are extremely complex and have required lengthy negotiations. Nonetheless, virtually all of the elements of the forthcoming convention are now available.

63. In drafting the convention, government delegations co-operate closely with military and technical experts and with experts from industry. Most of the unresolved questions are of a mainly political nature. Among these are the nature of the inspections on request, the possible need for ad hoc checks, the composition of the proposed Executive Council and its decision-making provisions, and the question of national reservations to the 1925 Geneva Protocol in relation to the proposed convention.

7/ General Assembly resolution 2826 (XXVI), annex.

8/ See appendix 1 of the report of the group of qualified experts established in pursuance of General Assembly resolution 42/37 C of 30 November 1987 (A/44/561, annex I).

9/ See the report of the Ad Hoc Committee on Chemical Weapons to the Conference on Disarmament on its work during the period 16 January to 1 February 1990 (Conference on Disarmament document CD/961).

B. Diplomatic constraints

64. The major diplomatic constraints on chemical warfare take the form of resolutions or decisions adopted by intergovernmental bodies. Individual States or groups of States can, of course, also make declarations of commitment at various levels. Such constraints, whether resolutions, decisions or declarations, can take the form of generalized condemnations of the use - or even the possession - of chemical weapons, or else they may be aimed at a specific violator, possibly calling for sanctions of one type or another.

65. The General Assembly has over the past twenty-five years adopted a series of resolutions condemning chemical warfare, starting with its resolution 2162 B (XXI) of 5 December 1966, by paragraph 1 of which it called for strict observance by all States of the principles and objectives of the 1925 Geneva Protocol and condemned all actions contrary to those objectives. In 1969, by its resolution 2603 A (XXIV) of 16 December, the Assembly declared as contrary to the generally recognized rules of international law, as embodied in the 1925 Geneva Protocol, the use in international armed conflicts of any chemical agents of warfare - chemical substances, whether gaseous, liquid or solid - which might be employed because of their direct toxic effects on man, animals or plants. By paragraph 75 of the Final Document of its Tenth Special Session, adopted by resolution S-10/2 of 30 June 1978, the Assembly stated that the complete and effective prohibition of the development, production and stockpiling of all chemical weapons and their destruction represented one of the most urgent measures of disarmament. More recently, by paragraphs 1 and 3 of its resolution 44/115 B of 15 December 1989, the Assembly renewed its call to all States to observe strictly the principles and objectives of the 1925 Geneva Protocol, condemned vigourously all actions that violated that obligation and urged the Conference on Disarmament to pursue as a matter of continued urgency its negotiations on a convention on the prohibition of the development, production, stockpiling and use of all chemical weapons and on their destruction.

66. The Governing Council has added its weight to these efforts. By its decision 14/9 B of 18 June 1987, the Council called upon all Governments to refrain from using chemical weapons of mass destruction that cause considerable threats to people and the environment, and, by its decision 15/9 of 25 May 1989, it expressed its deep concern at the devastating effects of chemical weapons on mankind and the environment and recognized the need for international scientific and technical co-operation in order to protect mankind and the environment from the devastating effects of chemical and other weapons of mass destruction.

67. The World Health Organization has also been active in this regard. In 1970, for example, the Twenty-third World Health Assembly adopted resolution WHA23.53, on the rapid prohibition of chemical and bacteriological (biological) weapons, by which it, inter alia, appealed once more to the Governments of countries that had not yet ratified the 1925 Geneva Protocol to accede to "that important and highly humane international agreement" in the nearest possible future, emphasized the need for the rapid prohibition of the development, production and stockpiling of chemical and bacteriological

(biological) weapons and the destruction of stocks of such weapons as a necessary measure in the fight for human health, and called upon all medical associations and all medical workers to consider it their moral and professional duty to give every possible assistance to the international movement directed towards the complete prohibition of chemical and bacteriological (biological) means of waging war.

68. Diplomatic constraints on chemical warfare can also derive from non-specific exhortations to avoid military activities damaging to the environment, such as that contained in principle 20 of the World Charter for Nature, adopted and solemnly proclaimed by the General Assembly by its resolution 37/7 of 28 October 1982, or to avoid the discharge of pernicious chemicals into the environment, such as, for example, the appeal of the Governing Council contained in its decision 53 (IV) of 13 April 1976, on chemical substances and physical agents whose effects on the environment are unknown.

69. Diplomatic constraints may also take the form of declarations by ad hoc intergovernmental conferences, having as a purpose the reinforcement of cultural and legal norms against the use of chemical weapons. One such example is the Final Declaration of the Paris Conference of States Parties to the 1925 Geneva Protocol and Other Interested States, 10/ adopted on 11 January 1989, by which the representatives of 149 States solemnly affirmed their commitments not to use chemical weapons, condemned such use, called upon all States that had not yet done so to accede to the 1925 Geneva Protocol, stressed the necessity of concluding, at an early date, a convention on the prohibition of the development, production, stockpiling and use of all chemical weapons and on their destruction, and reaffirmed their full support for the United Nations Secretary-General in carrying his responsibilities for investigations in the event of alleged violations of the Geneva Protocol.

C. Cultural constraints on chemical warfare

70. It must be recognized that legal and diplomatic constraints against chemical warfare represent the codified expression of existing cultural constraints against such activity. In the final analysis, these more or less formal prohibitions and admonitions are as strong as the public sentiment that underlies them. It is therefore a social and ecological boon that there appears to exist a widespread and longstanding repugnance towards chemical warfare, within both the military and the civilian sectors. Indeed, such repugnance gains in importance in an increasingly over-stressed biosphere.

71. Activities by considerable numbers of non-governmental organizations in various countries are directed at least in part to reinforcing the existing cultural norm against chemical warfare. In recent years, such activities have most often taken the form of attempts at hastening the intergovernmental efforts towards concluding a treaty that would prohibit the possession of chemical weapons. Other efforts have been directed towards preventing the development of toxin weapons by such biotechnological means as genetic engineering.

10/ A/44/88, annex.